Patent Office
Research and Development
Reports . . . . . No. 4

STORAGE AND RETRIEVAL OF CONTENTS OF TECHNICAL LITERATURE

NONCHEMICAL INFORMATION

First Supplementary Report
June 1957

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NONCHEMICAL INFORMATION

INTRODUCTION

This report is the second of a series, describing continued research on the linguistic method of encoding non-chemical scientific material for retrieval as outlined in the Preliminary Report[1]. The material covered in this report represents a part time effort of the author alone.

A few changes since the publication of the Preliminary Report are noted:-

1. In that Report we had used the terms generic and specific in a rather loose and inaccurate manner. The terms inclusive and subsumed are more accurate terms for these notions, and I shall use this latter terminology for describing them in the future. The terms generic and specific will be retained for use only with true Aristotelean hierarchies.
2. By an expansion of the use of the technique of modulation, I believe the problems of Serial Numbering (p. 9 of the Preliminary Report) may be avoided. (See pp. 11-13, below).
3. The itemization shown in Schedule 16 of the Preliminary Report can lead to a false retrieval if, as suggested, the particular order of items is ignored, since one could retrieve the result that C drives B. This schedule should be amended by the addition of an interrelation concept which would indicate the direction of the drive, e.g., DRIVER(DRIVEN) in precisely the same manner that the sequence of time was shown by TIMAFOR(TIMAFT) in Schedule 17.

SYMBOLOGY

The following symbology has now been determined. For interrelational concepts: those whose mirror images are identical with the cognate concepts, will be written with empty parenthesis immediately following the concept, as: EQUAL( ); those whose mirror images are different will have the image concept within a parenthesis immediately following its cognate concept, as: SMALLER(LARGER).

For modulants; a letter or a series of letters will be used, joined by means of an equal sign (=) to the root being modified, as: ENPACKAGE=OR. Since some modulants (at least in certain uses) are subsumed under other inclusive notions, I will utilize the letter(s) of the inclusive modulant and add additional letters for those subsumed: as = W for work, = WFP for work, final product.

For Ruly Roots: the term Root will be written with an upper case R.

INTERRELATIONAL CONCEPTS

Several groups of interrelational concepts have now been developed without reference to the breakdown of prepositions, in accordance with a possible procedure suggested in the Report[1] (last lines of p.7).

The first of these groups of related concepts to be developed was that of Relative Measurement.

Relative Measurement

A table of Roots, compliance codes, and explanations appears in Schedule 18.

In this schedule, APPROX( ) is indicated as inclusive of EQUAL( ), since, for example, any search for two dimensions approximately of the same size should retrieve two equal dimensions. APPROX( ) is also inclusive of SLILESS(SLIMORE) since the dimensions of parts which fit with small tolerance may be considered as approximately the same.

Another inclusive term LESS(MORE) has subsumed SLILESS(SLIMORE); and to distinguish these dimensions of fit from others, another term MATLESS(MATMORE) has been subsumed with its hierarchy of smaller (and larger) dimensions.

Location

A much more complex notion is that of LOCATION. LOCATION may be defined as the expression of the relative spacial position of one thing with reference to some other thing. Upon analysis, I have discovered that five distinct and separate conceptual groups are involved in this notion. I have termed them:-

1. ASSOCIATION
2. ALIGNMENT
3. PROPINQUITY
4. ORIENTATION
5. ARRANGEMENT

Definitions

The following definitions of terms are a prerequisite to defining, explaining and developing

RELATIVE MEASUREMENT

Root	Compliance Code	Explanation
EQUAL	1 0 0 0 0 0 0 0 0	equal
APPROX	1 0 0 0 0 0 1 1 1	approximately the same
LESS	0 1 1 1 1 1 1 0 1	smaller
MORE	0 1 1 1 1 1 1 1 0	larger
SLILESS	0 0 0 0 0 0 1 0 1	slightly smaller
SLIMORE	0 0 0 0 0 0 1 1 0	slightly larger
MATLESS	0 1 1 1 1 1 0 0 1	substantially smaller
MATMORE	0 1 1 1 1 1 0 1 0	substantially larger
TRIQUAT	0 0 1 1 1 1 0 0 1	3/4 or less
SESQUI	0 0 1 1 1 1 0 1 0	1 1/2 or more
HEMI	0 0 0 1 1 1 0 0 1	1/2 or less
TWICE	0 0 0 1 1 1 0 1 0	twice or more
FIFTH	0 0 0 0 1 1 0 0 1	1/5 or less
QUINTICE	0 0 0 0 1 1 0 1 0	five times or more
TENTH	0 0 0 0 0 1 0 0 1	1/10 or less
DECICE	0 0 0 0 0 1 0 1 0	10 times or more

SCHEDULE 18

Ruly concepts for these groups. These definitions are offered with full knowledge of the problems involved in defining Ruly words with unruly ones. For this reason examples have been used, wherever possible, to help in interpretation of the meanings of the unruly words used in the definitions.

A CONFORMATON may be defined as a geometrical shape or figure, in zero, one, two or three dimensions: e.g., a point, a line, a surface or a volume.

A BORDER constitutes the boundary, limit, or periphery of a CONFORMATION: e.g., the end of a line, the edge of a surface or the exterior surface of a volume.

SUBSTANCE constitutes the stuff or material included in a CONFORMATION: e.g., the point, the length of line, the area of surface, or the bulk of volume.

A PORTION of a CONFORMATION consists of a contiguous section of SUBSTANCE of the same dimensional order as the CONFORMATION of which it is a section: e.g., a hemisphere of a sphere, an area of a larger surface, a segment of a line.

An ELEMENT of a CONFORMATION consists of a contiguous section of SUBSTANCE of a smaller dimensional order than the CONFORMATION of which it is a section: e.g., a spherical triangle, an arc, or a point on the surface of a sphere; a line or a point on a surface; or a point in a line.

The SUBSTANCE of two or more CONFORMATIONS or ELEMENTS is considered to be COMMON when it occupies the same space at the same time: e.g., a PORTION of a CONFORMATION has COMMON SUBSTANCE with the CONFORMATION.

Two or more CONFORMATIONs are said to be in EXTACT when they have both (1) part of their BORDERs in COMMON, and (2) no PORTIONs in COMMON: e.g., two spheres externally tangentially touching, two triangles with a common side or vertex, or two lines, meeting at their ends to form an angle.

Two or more CONFORMATIONs are said t

INTERSECT when they have PORTIONs in COMMON, and other PORTIONs not in common: e.g., a cylinder passing complete through and extending beyond a cube, the sides of which are longer than the diameter of the cylinder.

One CONFORMATION is EMBEDDed within a second CONFORMATION when all of the SUBSTANCE of the first exists in COMMON with that of the second, and there exists no COMMON BORDER: e.g., a piece of aggregate in the interior of a cement body.

One CONFORMATION is SURROUNDed by a second CONFORMATION when all of the SUBSTANCE of the first exists in COMMON with the second, and some, but not all, of the two BORDERs exists in COMMON: e.g., a piece of terrazzo tile in a floor.

Two congruent CONFORMATIONs are said to be COINCIDEnt when they have all SUBSTANCE in COMMON: e.g., two congruent CONFORMATIONs, superposed to demonstrate their congruence.

A CONFORMATION is said to have POLARity when one ELEMENT or PORTION thereof has a contrasting characteristic which distinguishes it from other ELEMENTs and PORTIONs of the CONFORMATION: e.g., the front of a piece of furniture.

Because the term CONFORMATION is inclusive of figures of from zero to three dimensions, certain of the defined terms which have unique meanings when applied to multi-dimensional figure may describe the same LOCATION in a figure of smaller dimensions: e.g., the CONFORMATION, SUBSTANCE and PORTIONs of a point (zero dimensions), are each the point itself; similarly, for two linear CONFORMATIONs, a PORTION might be INTERSECTing and at the same time, be EMBEDDed if it were a central PORTION, or be SURROUNDed if it extended to one BORDER of the CONFORMATION, etc.

There follows a definition and explanation of the five conceptual groups which constitute the notion of LOCATION.

Association

A table of Roots, compilance codes and explanations appears in schedule 19.

ASSOCIATION is defined as the expression of the spacial occupancy of two or more CONFORMATIONs in terms of what PORTIONs or ELEMENTs (if any) exist in COMMON. There are two mutually exclusive conceptual notions of ASSOCIATION:-

I. SEPFROM( ) defining two or more separated CONFORMATIONs with no COMMON SUBSTANCE: e.g., two spaced spheres, and
II. All other situations, i.e., CONFORMATIONs that have some COMMON SUBSTANCE. This is a highly complex hierarchy, and has three coordinate breakdowns:-

IIA. INTERSEC( ) defining those CONFORMATIONs with both COMMON PORTIONs and with some ELEMENTs existing in COMMON; e.g., a cylinder piercing a sphere of larger diameter than the cylinder. It should be noted that this term is also subsumed from both IIB COMPOR( ) and IIC COMBOR( ), defined later;
IIB. COMPOR( ) defining those CONFORMATIONs which have COMMON PORTIONs. This term is inclusive, not only of all of IIA1 IN-

ASSOCIATION

ROOT	COMPLIANCE CODE	EXPLANATION
SEPFROM( )	0 0 0 0 0 0 0 0 0 1	Nothing in COMMON
INTERSEC( )	0 1 0 0 0 1 1 0 0 0	PORTIONs COMMON and nonCOMMON
SURTACT	0 1 0 0 0 1 0 0 0 0	SURROUNDing and in contact
INTACT	0 1 0 0 0 0 1 0 0 0	SURROUNDed and in contact
COINC( )	0 0 0 0 1 0 0 0 0 0	COINCIDEnt
COMPOR( )	1 1 1 0 1 1 1 1 1 0	COMMON PORTIONs
ENCLOS	0 0 1 0 0 0 0 1 0 0	Enclosing, no COMMON BORDER
EMBED	0 0 1 0 0 0 0 0 1 0	Enclosed, no COMMON BORDER
COMBOR( )	1 1 0 1 1 1 1 0 0 0	COMMON BORDER
EXTACT( )	0 0 0 1 0 0 0 0 0 0	external contact

SCHEDULE 19

TERSEC( ), above, but of IIB1 ENCLOSE(IMBED), defined later; and

IIC. COMBOR ( ) defining those CONFORMATIONs which have some parts of their BORDERs in COMMON. This term is inclusive, not only of all of IIA1 INTERSEC, above, but of IIC1 EXTACT( ), defined above.

Subinclusive COMPOR( ) is inclusive of:

IIA1. INTERSEC( ), defined above and

IIA2. COINC( ), defining two or more COINCIDEnt CONFORMATIONs: e.g., any two congruent bodies occupying the same space.

IIB1. ENCLOS(EMBED), defining one or more CONFORMATIONs EMBEDDed within another, i.e., one or more CONFORMATIONs which consist entirely of SUBSTANCE of another CONFORMATION, and in which a BORDER of one completely surrounds and does not INTERSECT the BORDERs of the other CONFORMATIONs: e.g., a piece of aggregate EMBEDDed in a cement object. The EMBEDDing CONFORMATION is termed ENCLOSE, the EMBEDDed CONFORMATION is termed EMBED.

Subinclusive INTERSEC( ) is itself inclusive of:

IIA1a. SUBTACT(INTACT), defining two or more INTERSECTing CONFORMATIONs in which one CONFORMATION is SURROUNDED by another, i.e., the entire SUBSTANCE of one of the CONFORMATIONs exists as a PORTION of another of the CONFORMATION, and portions of the two BORDERs are COMMON: e.g., a piece of terrazzo tile in a floor. The surrounding CONFORMATION is the SUBTACT, while the surrounded CONFORMATION is the INTACT.

COMBOR( ), as noted above, is also inclusive of:

IIC1. EXTACT, already defined.

Alignment

The Roots, compliance codes and explanations of ALIGNMENT are shown in Schedule 20.

ALIGNMENT

ROOT	COMPLIANCE CODE	EXPLANATION
BYPASS( )	1 1 0 0	Axes never meet
OFFSET( )	1 0 0 0	Parallel axes
ASKEW( )	0 1 0 0	Non-parallel axes in separate planes
MEET( )	0 0 1 1	Meeting axes
INLINE( )	0 0 1 0	COINCIDEnt axes
ANGLE( )	0 0 0 1	INTERSECTing axes

SCHEDULE 20

ALIGNMENT is defined as the expression of the relation of the axes of (A) two or more CONFORMATIONs or (B) two or more PORTIONs and/or ELEMENTs of the same or different CONFORMATIONs. Since an axis is itself a CONFORMATION, we find ALIGNMENT to break down in the same manner as CONFORMATION, i.e., those axes which are separate (i.e., never meet) and those which have COMMON ELEMENTs.

There are two hierarchies of ALIGNMENT:

I. BYPASS( ), which defines objects with axes that do not meet, and which is inclusive of:

IA. OFFSET( ), which defines objects with two parallel axes: e.g., a cam surface is OFFSET from its axis of revolution, and

IB. ASKEW( ), which defines objects with two non-parallel axes in different planes, e.g., the steering column of a standard automobile is ASKEW to the rear axle.

II. MEET( ), which defines objects with meeting axes, and which is inclusive of:

IIA. INLINE( ), which defines objects with a COMMON axis: e. g., an assembled nut and bolt, and

IIB. ANGLE( ), which defines objects with INTERSECTing axes: e.g., two meshed bevel gears.

Propinquity

The interrelational concepts of RELATIVE MEASURE will be used for PROPINQUITY. See Schedule 18.

PROPINQUITY is defined as the expression of the relative spacing of two CONFORMATIONs, PORTIONs or ELEMENTs with respect to a standard, which may be a dimension of some third CONFORMATION, PORTION or ELEMENT: e.g., two holes in a lever may be spaced (1) one inch apart or (2) at a distance greater than the width of the lever.

Orientation

Roots, compliance codes and explanations of ORIENTATION will be found in Schedule 21.

ORIENTATION

ROOT	COMPLIANCE CODE	EXPLANATION
AMONG( )	1 1 1	In a group
BETWEEN	1 0 0	Center of three in a row
BETWIX	0 1 1	The two outside of three in a row
STANWIX	0 0 1	One of BETWIX, when a standard

SCHEDULE 21

ORIENTATION is defined as the expression of the relative spacial relations of three or more ALIGNED CONFORMATIONs; or PORTIONs or ELEMENTs of the same or different CONFORMATIONS, with respect to one or more as a standard: e.g., the coupling extends between the tractor and the trailer.

The situation may be represented by three ALIGNed objects:

L M N

in which M is BETWEEN L and N, and L and N are BETWIX M. If either L or N is the standard, then that part of the BETWIX concept will be STANWIX. E.g., the object-BETWEEN is BETWIX the light-source and the screen on which its shadow falls. Also, the umbrella-BETWEEN is STANWIX-me and the rain-BETWIX.

We may also have the broader concept AMONG( ), which is inclusive of both the cognate parts of the concept BETWIX(BETWEEN): e.g. the nut fell AMONG the parts strewn on the floor.

BETWIX is obviously inclusive of the complex concept part BETWIX(STANWIX).

Arrangement

The Roots, compliance codes, diagrams and explanations are found in schedule 22.

ARRANGEMENT is defined as the expression of a significant facing relation between two particularly designated POLARized CONFORMATIONs, or PORTIONs of one CONFORMATION: e.g., the muzzle of a gun is pointed towards a target.

There are three mutually exclusive interrelational concepts of ARRANGEMENT, viz:

I. FACE( ), where the two POLARIZed PORTIONs are closest to one another: e.g., the plug of an electric bulb must FACE the socket of the fixture before assembly.

II. OPPOS( ), where the two POLARIZed PORTIONs are located most remotely from one another: e.g., the two muzzles of a bazooka are on OPPOSed ends of the barrel.

III. PRECED(FOLLO), where the two POLARIZed PORTIONs are located in the same relative position, on two CONFORMATIONs or PORTIONs: e.g., shells axially ALIGNed and assembled with their bullet heads facing in one direction in the cylindrical magazine of a rifle.

Recapitulation

To recapitulate and compare these notions of LOCATION, let us consider a plumb bob hanging over the head of a nail, partially driven into the floor, with the distance between the point of the bob and the head of the nail being less than the length of the bob. As to ASSOCIATION, the nail and bob are SEPFROM( ), i.e., separated; as to ALIGNMENT, they are INLINE( ), i.e., their axes are COMMON; as to PROPINQUITY, they are separated by a distance-LESS than the length-MORE of the bob; to ORIENTATION the head of the nail is BETWEEN the floor-BETWIX and the bob-BETWIX; and to ARRANGEMENT the nail-PROCED the bob-FOLLOW.

The use of these Ruly terms in itemizing a disclosure is shown later in this paper(Schedule 25) in conjuction with other notions, which will be described later.

MODULANTS

A list of modulants with brief explanations of their meanings will be found in Schedule 23.

A more critical and thorough analysis of the modulant problem indicates that the superficial analysis which we had made in the Preliminary Report[1] falls quite short of developing a useful solution to the problem. At that time, it was stated that modulants other than those mentioned would be needed and that of those forms detailed, some would not be useful with all Roots. This has proven true and further analysis now indicates not only that additional types of modulants are needed but that Root types exist which are basically different in their modulation.

Dual-Aspect Roots

Certain processes, including those which involve the direct transfer of energy (as opposed to those in which energy is transduced from one form to

ARRANGEMENT

ROOT	COMPLIANCE CODE	DIAGRAM	EXPLANATION
FACE( )	1 0 0 0	→ ←	Face to face
OPPOS( )	0 1 0 0	← →	Back to back
PRECED	0 0 1 0	←	Precede
FOLLO	0 0 0 1	←	and follow

SCHEDULE 22

MODULANTS

MODULANT	EXPLANATION	*SOURCE
=NT	Process	1 2
=OR	Apparatus or performer	1 2
=W	Work	1 2
=WSM	Starting Material	2 3
=WIP	Intermediate Product	1 3
=WFP	Final Product	2
=WID	Ingredient Descriptor	3
=WCD	Composition Descriptor	3
=M	Made from (made out of)	1 2
=MSM	Source Material	3
=MCC	Component of Complex	2 3
=MCI	Combination Including	1 2
=SW	Subcombination of whole	2
=E	Condition	1 2
=EP	Before process	
=ED	During process	
=ER	After process	3
=IS	Disease of	3
	Numerical	
=X	Or more	
=Y	Exactly	
=Z	Or less	
=B	Used as an ordinal	

*Since many of these modulating notions were derived from others, or are closely related to modulants suggested by them, included is a source column, where the numbers refer to the references listed at the end of this paper.

SCHEDULE 23

another) require the creation of what is here called dual-aspect Roots. Where energy is directly transferred, a process is sometimes the mirror image of its inverse process. For example, when a first object is heated by direct transfer of energy from a second object, the second object which supplies the energy is normally cooled--unless this second object is either being supplied with additional energy from an outside source, or unless it has such a vast supply of entrained energy that no substantial loss occurs; or unless the first object which receives the energy has a substantially unlimited energy storage medium, either connected to it or built-in, and of such size that no substantial gain of energy occurs.

The term dual-aspect will be applied to those cases in which there is no unlimited supply or storage for the energy. As an example, the dual-aspect Root HEATCOOL when modulated as a process might refer to the action of a hot piece of steel being tempered by plunging it into a small tank of oil, the steel being cooled as the oil temperature is raised. If the tank contained a large supply of oil, the normal Root COOL alone would be used in describing the action, since the temperature of the oil would not be substantially changed.

It should be particularly noted that in dual-aspect cases, there can be no modulant of apparatus or performer. Both objects taking part in the process are work. On the other hand, in the example using the large tank of oil, the steel constitutes the work and the oil the performer.

Dual-aspect situations must be critically analyzed. Consider the driving of a nail by means of a hammer. The uncritical approach that the hammer is a performer and the nail the work must be avoided. The nail decelerates the hammer and adsorbs its energy, hence both the hammer and the nail are work, and no apparatus in the Ruly sense is involved.

Numerical Modulants

Cardinal numerals used as Roots may be modulated as shown in the bottom of Schedule 23. Thus we might have: 10=X, ten or more; 7=Y, exactly seven; etc.

However, when referring to part of a group, interrelational concept OUTFROM(FROMOUT) is used; and when referring to all of a group, the interrelational concept CONSISTOF( ) is used. For example, the expressions "six of ten . . . ", "some of the eight . . . ", and "all three . . . " are itemized in Schedule 24.

Substitute for Serial Numbering

The Preliminary Report[1] (p9, col.2) contained a proposal for the use of Serial Numbering in the encoding of complex structures. It now appears that with the =MCI and the=SW modulants, the use of serial numbers can be avoided, and the difficult problem of blind retrieval, which a system of Serial Numbering would require, can also be avoided. For example, in the specification of the application printed in "Problems in Mechanizing the Search in Examining Patent Applications", the disclosure of the bead chain might be itemized, in part, as shown in Schedule 25.

Item No.	Root	Interrelational Concept and Interfix
1	6	OUTFROM-1
2	10	FROMOUT-1
7	SOME	OUTFROM-3
8	8	FROMOUT-3
15	ALL	CONSISTOF-5
16	3	CONSISTOF-5

SCHEDULE 24

In this schedule, the four or more beads of item 1 are designated by interfix 1 as the starting material for the chain of item 2, which is the resulting final product. Interfix 2 shows that each of the beads of item 1 comprises the spheres of items 3 and 4 and the cylinder of item 5. The process of assembling the beads into the chain is distributed between items 1 and 2, by means of interfix 3. This interfix and its interrelational concept STOCKFROM(CONSISTOF), at the same time designate the stock and the finished article.

Interfix 4 designates the beads in unassembled condition in item 1 and in assembled condition in item 2.

The sphere of item 3 has a diameter greater than that of the sphere of item 4 (interfix 5) and greater than that of the cylinder of item 5 (interfix 6). The association of the sphere of item 3 with the cylinder is that of INTERSEC (interfix 7); its alignment with both the sphere of item 4 and the cylinder is IN-LINE (interfix 8); and its orientation with these two items is shown by the interrelational concept BETWIX(BETWEEN) as one of the two outside objects, the sphere of item 4 being the other outside object and the cylinder being BETWEEN them. The remaining relationships are similar to those previously described.

The redundancy in these descriptor sets is, of course, necessary since the approach a question

ITEM NO.	ROOT & MODULANT (With Interfix)	INTERRELATIONAL CONCEPT (With Interfix)
1	BEAD=4X=WSM-1	
	BEAD=MCI-2	
	ASSEMBLE=NT	STOCKFROM-3
	ASSEMBLE=EP-4	
2	CHAIN=WFP-1	
	ASSEMBLE=NT	CONSISTOF-3
	ASSEMBLE=ER-4	
3	SPHERE=SW-2	
	DIAMETER	MORE-5
	DIAMETER	MORE-6
	ASSOCIATION	INTERSEC-7
	ALIGNMENT	INLINE-8
	ORIENTATION	BETWIX-9
4	SPHERE=SW-2	
	DIAMETER	LESS-5
	DIAMETER	MORE-10
	ASSOCIATION	INTERSEC-11
	ALIGNMENT	INLINE-8
	ORIENTATION	BETWIX-9
5	CYLINDER=SW-2	
	DIAMETER	LESS-6
	DIAMETER	LESS-10
	ASSOCIATION	INTERSEC-7
	ASSOCIATION	INTERSEC-11
	ALIGNMENT	INLINE-8
	ORIENTATION	BETWEEN-9

SCHEDULE 25

may take is not known in advance. For example, by means of this schedule, the disclosure can be retrieved by a question which seeks (1) a finished chain made of beads; (2) the process of assembling beads into a chain; (3) four or more beads unassembled; (4) four or more beads assembled, etc.

Modulants Proposed By Chemical Task Force

The modulants which have been proposed by the Chemical Task Force[3] and their relation to Ruly language have been considered in detail. These unpublished proposals will be found in Appendix A.

Of their W-type modulants ingredient descriptor and composition descriptor have been considered as subinclusive of the modulant =W (Work), since they will normally refer to something useful in a *manufacturing process. Starting material and final product had already been incorporated in the list of modulants as =WSM & =WFP respectively. Since a thing may be a =WFP with respect to one process, and at the same time a =WSM with respect to a second process, these =W modulants and the =NTs with which they are concerned should be interfixed, i.e., they should carry the same interfix number.

The Y-type modulants require a somewhat more exhaustive analysis. Let us consider a process where an ingredient A is oxidized by an oxidizing agent B to yield an oxidized product C and a reduced agent D. This is, of course, a dual-aspect process. I shall adopt a Root from the known chemical term redoxi, viz REDOXI. In the use of a dual-aspect Root, I shall adopt a convention that any reference to a condition will always be made to the first recited half of a dual-aspect process--in this example to the reduction and not to the oxidation; therefore, any reference to a condition in REDOXI=NT will refer to a stated potential of reduction. As an example, the REDOXI=NT above can be itemized as taught in the Preliminary Report, with the interfix modification suggested above (p. 11). This is shown in Schedule 26. Had I named this Root "oxired" instead of REDOXI, the "mores" and the "lesses" in Schedule 24 would be reversed. Hence the notions of active, passive, stated potential and stated potential fulfilled can be otherwise handled in my proposed system. The last Y-type modulant, resultant, has been adopted as the one of the condition modulants: =ER.

Of the Z-type modulants the first two, (viz, component of complex and source material) have been assigned as subsumed beneath the modulant =M (made from or made out of). The next modulant, disease of, which is probably peculiar to medicine has been given the designation =IS (as in tonsilitis, psychosis etc.). The next three "modulants", disease by and its two subsumed terms, infection by and toxicity by, are not true modulants in my system. They are directed to the complex notion of a disease, a part of the body diseased with a cause-result interrelation concept between them. For example, the expressions: "Tonsils infected by streptococus" and "Nausea, toxicity by botulina" can be itemized in my system as shown in Schedule 27. The last "modulant," miscellaneous specific has been used by the Chemical Task Force to designate an unnamed or unlisted species of a particular genus. For example, under the genus motors, there might be listed only three species: e.g., electrically driven, steam driven and spring driven. A disclosure of an animal driven motor (i.e., a treadmill) would belong to none of the listed species, and would therefore have to be placed with the genus, motors. To distinguish such an unlisted species from a true generic motor disclosure.

*Manufacturing is used here in its broadest sense, which includes any process of creating, constructing, fabricating, machining, working, shaping, assembling, disassembling and/or repairing a thing.

Item No.	Root and Modulant	Interrelational concept and modulant
1	A=WSM-1	
	REDOXI=NT-1	TIMAFOR-2
	REDOXI=EP	MORE-3
2	B=WSM-1	
	REDOXI=NT-1	TIMAFOR-2
	REDOXI=EP	LESS-4
3	C=WFP-1	
	REDOXI=NT	TIMAFT-2
	REDOXI=ER	LESS-3
4	D=WFP-1	
	REDOXI=NT-1	TIMAFT-2
	REDOXI=ER	MORE-4

SCHEDULE 26

would require the modulant miscellaneous specific. Since in the past the Patent Office has used the same generic classification for both true genera and for miscellaneous specific species, this notion has been important in retrieval of information. Whether this notion need be applied in this proposed encoding system has not yet been analyzed.

Specific Modulants

A study of the analysis of ENPACKAGE, as defined and detailed in the Preliminary Report, indicated that a plurality of different, overlapping, interrelated, and non-exclusive factors were involved in its meaning. Accordingly the analysis of this term has been deferred and several others have been considered which seemed to be less complex in meaning.

Of Movement

The first one considered was that of MOVEment. Schedule 28 shows the Roots, compliance codes and explanation of the factors subsumed under this term.

MOVE, as defined by its process MOVE=NT, is the change of the spacial position of a CONFORMATION.

TRANSL, as defined by its process TRANSL=NT is the change of the spacial position of a CONFORMATION in which each point of that CONFORMATION simultaneously travels in a straight line.

ROTAT, as defined by its process ROTAT=NT is the change of the spacial position of a CONFORMATION, in which each point of that conformation simultaneously travels in the arc of a circle around a given center point.

REVOL, which is subsumed under ROTAT, is defined by its process REVOL=NT as a process of ROTAT=NT in which the center point is within the BOUNDARY of the conformation.

As example of MOVEment modulation let us consider a piece of cloth being hemmed in a sewing machine. The cloth becomes the TRANSL=W. After it is first folded and placed beneath the foot of the machine it becomes TRANSL=EP. While the hem is being sewed and it is in movement thru the machine it becomes TRANSL=ED. After the process of sewing is completed and the machine is at rest, the piece becomes TRANSL=ER. The foot and its cooperating feed member constitute the TRANSL=OR, the process of transportation thru the TRANSL=OR is termed TRANSL=NT.

The other modulants do not appear applicable to MOVE.

Of Configuration Change

A slightly more complex Root would be SHAPE. SHAPE=NT is defined as the change of the configuration of a thing without the removal of any of the SUBSTANCE of which it is made: e.g., the metal processing steps such as forging or bending.

MOVEMENT

Root	Compliance Code	Explanation
MOVE	1 1 1 1	Movement
TRANSL	0 1 0 0	Translation
ROTAT	0 0 1 1	Rotation
REVOL	0 0 0 1	Revolution

SCHEDULE 28

Item No.	Root and Modulant	Interrelational Concept and Interfix
1	TONSILS INFECT=NT	MEANSFROM-1
2	STREPTOCOCUS INFECT=NT	MEANSBY-1

———————○———————

8	NAUSEA=ER TOXICITY=NT	MEANSFROM-8
9	BOTULINA TOXICITY=NT	MEANSBY-8

SCHEDULE 27

In the forging of a crankshaft from a billet, SHAPE=NT would be done by a SHAPE=OR or forging press; the billet would be the SHAPE=WSM in the condition of SHAPE=EP; the partially shaped blanks would be SHAPE=WIP in the condition of SHAPE=ED; and the finished crankshaft would be SHAPE=WDP in the condition of SHAPE=ER. Again, the remaining modulants do not appear applicable to this Root.

Of Fastening

Because of certain implications in its modulants, an interesting root often found in non-chemical technology is FASTEN. This Root may be defined by its method FASTEN=NT as maintaining two or more things together: e.g., holding together two stapled sheets of paper, or two welded metal parts.

The apparatus or performer, FASTEN=OR, is the device which performs the FASTEN=NT, i.e., the staple or the weld. The stapling machine is not the FASTEN=OR; it is either the ASSEMBLE=OR or the FASTEN=OR maker plus the ASSEMBLE=OR. It should be noted that the FASTEN=OR can be a part of the thing FASTEN=NT. The FASTEN=W consists of at least two things which are maintained together: e.g., the two sheets of paper or metal parts.

Of Substance

The several Roots just considered are capable of being modulated as processes. There are some Roots which cannot be so modulated. For example, consider a Root such as STEEL, the iron carbide alloy. In the previously described shaping process, the billet could be described STEEL=WCD, and the crankshaft could be described STEEL=MSM. Again the other modulants do not seem to be applicable to this Root.

Of Transfer of Energy

A still different type of Root is HEAT. HEAT=NT is defined as the act of raising the temperature of a thing. We should note that the un-Ruly noun "heat" is really a nonsense word. One cannot add "heat" to a body, or extract or derive "heat" from it. Such loose notions, if expressed in material to be coded will have to be redefined in some other Ruly notion. In addition to the process HEAT=NT, we could have HEAT=OR, a flame or a furnace. A HEAT=W and its subsumed modulants would be anv WORK which was heated, as an ingot or a bread dough.

The WORK could be characterized by any of the =E (condition) modulants. There would be no =OR modulant of the dual-aspect Root HEATCOOL. In the previous example of the hot copper ball and the container of cool oil, both the hot copper and the cool oil would be HEATCOOL=WSM; the cool copper and the hot oil would be HEATCOOL=WFP.

QUALIFIERS

An inspection of several patent specifications for qualifying notions reveals that many cannot be directly coded and itemized. Referring to the specification of the application printed in "Problems in Mechanizing the Search in Examining Patent Applications,"[4] in paragraph 12 we find the term flexible in the first sentence; and in paragraph 23, the terms short and comparatively thin in the first sentence and plastic in the fourth sentence.

If only the actual wording of this specification is considered, these qualifiers are, in one sense, nonsense terms, in that no standard of comparison has been included in the specification. The entrance to the socket part of the separable fastener is stated to act "resiliently," (paragraph 8, second sentence). Almost everything has some resiliency. Other types of resiliency will be found in diving boards for swimming pools, I-beams for bridges and springs for watches. Each may be termed "resilient." Obviously an I-beam used on a highway bridge and a balance wheel spring of a watch have widely different degrees of resiliency.

In our Preliminary Report[1] we found that the Aristotelean system of classification was not applicable to our interrelational concepts, since the same "species" is often subsumed from two different and mutually exclusive "genera." Now, as I examine the qualifiers which may be used as descriptors, I find that Aristotle's "law of the excluded middle" gives us terminology and notions which I cannot utilize, since nothing in this field is really "black" or "white," but exists in some relatively broad shade of "grey."

Therefore in constructing qualifiers into Roots, I cannot utilize the many classifications which have been made in the past on the theory of this law: e.g., qualifying terms from Roget's Thesaurus will have to be modified to avoid this confusion.

Returning to the wording of the patent specification, one has a reasonably clear idea of what is meant by each of the quoted terms, for he draws on his past experience and adds this to the mere recitation of the words, creating or assembling a two part context which then becomes meaningful. That is, the person "skilled in the art"[5] supplies from his skills an appropriate quantifier for the qualifier, and a given term then takes on a relatively unambiguous meaning in the whole context.

Hence, when the inventor refers to a resilient socket edge, one recognizes that there must be enough resiliency to yield without breaking or tearing when the projecting head of the fastener is inserted, and that this yielding must allow for manual manipulation in the fastening process without allowing the joint to separate under the weight of a hanging "string" of beads.

Slightly-Substantial Notion

It is proposed therefore, that one of two quantifiers be added to the qualifier "resilient": e.g., "slightly" or "substantially". The socket edge, like the bridge beam, would be "slightly resilient"; a watch spring and a foam rubber chair seat would be "substantially resilient." The resilience of the diving board perhaps lies somewhere between the "slight" and the "substantial." In such a situation, both terms should be encoded as descriptors, and these two descriptors would retrieve the item, no matter which quantifier the encoder of a question used.

The use of this loosely bifurcate division of "slightly" and "substantially" immediately reveals the other horn of a dilemma. Things which are "slightly resilient" are also, by the very mode of this proposed division, "substantially rigid." On the other hand, things "substantially" rigid are also "slightly" resilient, if one assumes that resilient and rigid are mirror-image descriptors of this notion.

In this particular case, there appears to be no other image, but will further analysis yield some qualifying terms which may have two or more images? If not, perhaps there is a "substantial" solution to the encoding of qualifiers. A Root RESILRIG for this resilient-rigid notion can be coined, and it can be treated in a way similar to that proposed for the coding of dual-aspect terms (see p. 9 above).

Where the qualifiers are those of size, LOCATION, etc., the quantifying standard of comparison may be found in the context either by recitation of a particular point on a scale, or by the presentation of an illustration. The patent specification merely states that the neck of the bead fastener is "short", but the standard may be found in the drawing. As illustrated, its length is "substantially" EQUAL to its diameter and much LESS than the depth of the sockets. These relative dimensions can be encoded by the use of the "Relative Measure" (Schedule 18). It will be noted that this schedule includes both a substantially more than and a substantially less than grouping, so that proper coding of the more definite quantifiers in the lower portions of the schedule will fall within or without the substantial quantifier.

It may happen that certain scalar quantities, such as, the Brinell standard of hardness or a position in the E. M. F. series, may not be compatible directly with the relative measurement codes. In such cases, perhaps, some expert could arbitrarially indicate a division between slight and substantial or designate a set of three ranges, the middle range failing to define either slight or substantial. In this later case, where a range of values bridges the slight-substantial boundary, both terms must of course be encoded.

Concluding Remarks

I wish to acknowledge the many helpful and constructive comments and suggestions made by the readers of the Preliminary Report[1], and from the staff of both this Office, and the Data Processing Systems Division of the National Bureau of Standards. Corrections, suggestions and comments on this report, or on previous reports will be most welcome. Again, I gratefully acknowledge the counsel and advice of the Director, who has frequently given his time, experience and insight to the furtherance of this project.

APPENDIX A

The Chemical Task Force has proposed the use of three sets of Modulants, as follows:

W Type

Ingredient descriptor	0001
Composition descriptor	0010
Starting material	0100
Final Product	1000

Y Type

Active, potential	0010
Active, Potential fulfilled	0011
Passive, Potential	0100
Passive, Potential fulfilled	0101
Resultant	1000

Z Type

Component of Complex	0001
Source material	0010
Disease of	0011
Disease by	0100
Infection by	0101
Toxicity by	0110
Miscellaneous specific	1000

REFERENCES

(1) Patent Office Research and Development Report, "Storage and Retrieval of Contents of Technical Literature, Non-Chemical Information, Preliminary Report, May 15, 1956."

(2) James W. Perry et al, "Machine Literature Searching" 1956, pp. 84-89.

(3) Unpublished information from the files of the Chemical Task Force, Office of Research and Development, U. S. Patent Office; see appendix A of this report.

(4) Patent Office Research and Development Report, "Problems in Mechanizing the Search in Examining Patent Applications," 1956.

(5) This expression is used in the Patent Office to refer to the worker in the particular field of endeavor to which an application or patent is directed.

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